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New mosquito records (Diptera: Culicidae) from northwestern Argentina

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Abstract: The geographic distributions of *Aedes casali*, *Ae. meprai*, *Culex acharistus*, *Cx. bidens*, *Cx. coronator*, *Cx. dolosus*, *Cx. saltanensis*, *Cx. imitator*, *Haemagogus janthinomys* and *Psorophora cyanescens* are extended. This contribution updates the mosquito fauna listed for Argentina, increasing the number of species for the provinces of Jujuy, La Rioja and Santiago del Estero from 55 to 62, 22 to 25 and 25 to 26, respectively. Data on collection localities, habitat of immature stages, and health importance are also presented.

Key words: mosquito diversity; distribution; Prepuna; Yungas; Chaco; Monte

Argentina has been the scene of epidemics of mosquito-borne diseases, and therefore, there has been a concentration of several studies related to the diversity of these insects in the first half of the 20th century (Linares et al. 2011). Subsequent re-emerging diseases such as dengue fever, and the emergence and spread of the St. Louis encephalitis over the last two decades (Almirón 2010; Contigiani 2010) have motivated the continuation and expansion of the studies on mosquitoes in the country. Knowledge of the distribution of mosquito species is of great importance for determining areas of potential risk for pathogen transmission. It also serves to improve management programs. Examples of these types of studies are by Darsie (1985) and Campos and Maciá (1998). The most recent updated list of species of culicids for Argentina is the annotated checklist by Rossi (2015).

The aim of this study is to present new mosquito records from northwestern Argentina.

Immature specimens and adult mosquitoes were collected between 2011 and 2015, in Jujuy, Santiago del Estero and La Rioja provinces, during ecological and entomological surveillance of arboviral diseases. Adult mosquitoes were captured with CDC-light traps baited with CO_2. Immature stages were collected from puddles, ponds and pools at ground level with a 300-ml dipper, and from bromeliads using a manual suction pump. When possible, larvae were individually reared to obtain larval and pupal exuviae associated with the respective adult. The life stages abbreviations and other terms used follows: male (M), male genitalia (MG), female (F), pupa (P), pupal exuviae (Pe), fourth-instar larva (L), larval exuviae (Le), person who identified the specimens (det.) and the collector (coll.).

Specimens were collected at 25 sites (20 in Jujuy, 1 in Santiago del Estero and 4 in La Rioja provinces) (Figure 1). All sites with geographic and climatic data are summarized in Table 1. Phytogeographic regions follow Cabrera (1976), while climatic characteristics are based on Rivas-Martínez and Rivas-Sáenz (2015). Terminology corresponds to Bram (1967), Harbach and Knight (1980, 1982), Harbach et al. (1986) and abbreviations of genera and subgenera follow Reinert (2009). Rossi (2015) is used as the basis for updates to the distribution of species in Argentina.

Specimen collection data, such as month, number of examined and deposited individuals, stage and sex, collectors and current distribution for each species are included. Materials collected were mounted as follows: adults in cardboard triangles with steel pin support, while immature stages and genitalia structures in Canada balsam on microscope slides. Voucher specimens from La Rioja province are deposited in the

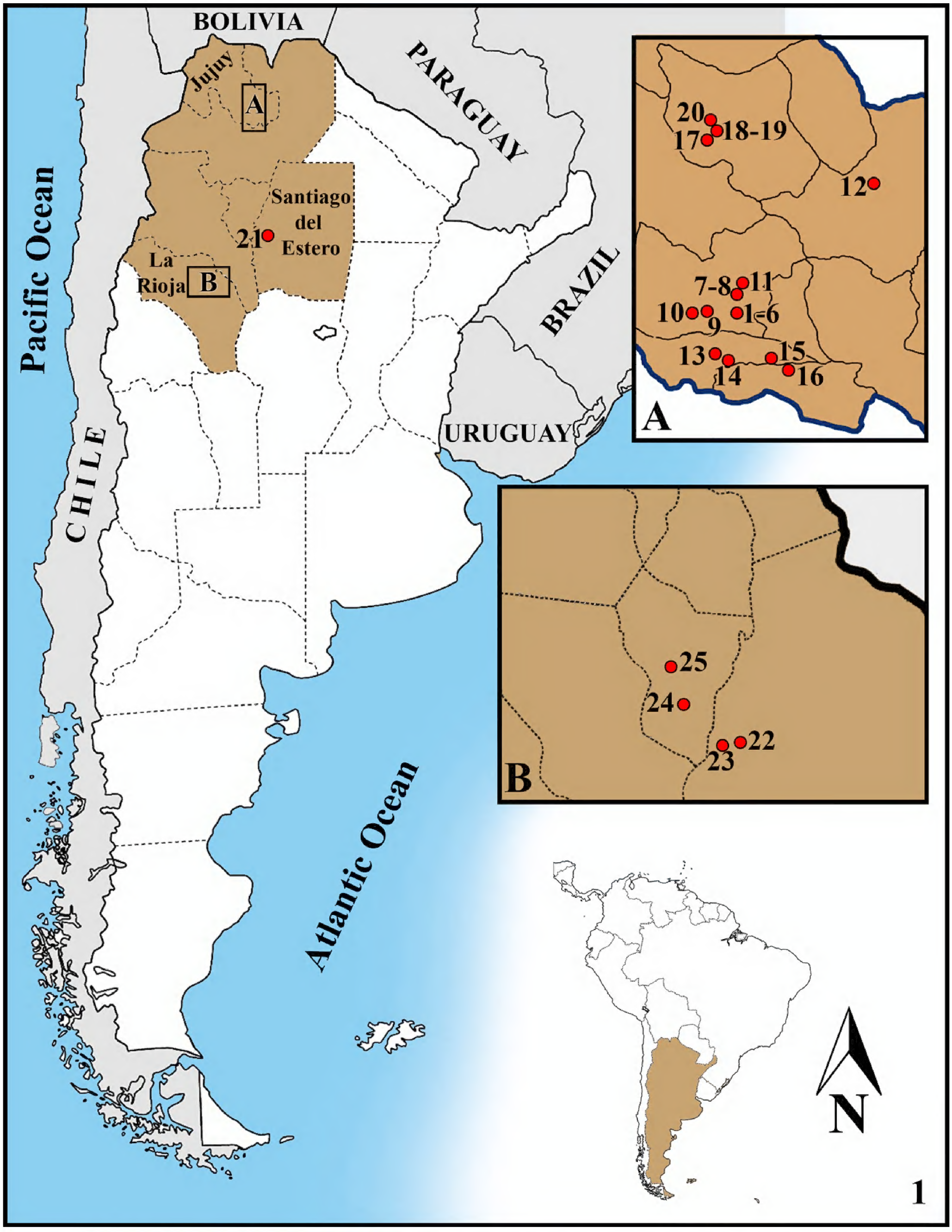


Figure 1. Sampling sites in northwestern provinces of Argentina. Jujuy province (A). 1–6: San Salvador de Jujuy; 7–8: Chijra, 9: Reyes; 10: Guerrero; 11: Barro Blanco; 12: Ledesma; 13: La Toma; 14: San Antonio; 15: Severino; 16: Perico; 17: Tumbaya; 18: Maimara; 19: Tilcara; 20: Huacalera. Santiago del Estero province: 21: Santiago del Estero. La Rioja province (B). 22–23: La Rioja; 24: Villa de Sanagasta; 25: Huaco. Geographic and climatic data of sampling sites are presented in Table 1.

Table 1. Geographic and climatic data of sampling sites in northwestern provinces of Argentina. Site numbers correspond to mapped site numbers in Figure 1.

Province	Site #	Locality / place	Environment	Lat (S)	Long (W)	Alt (m)	Phytogeo-graphical province	Climate
Jujuy	1	San Salvador de Jujuy	urban	24°9′47.5″	065°18′51.78″	1366	Yungas	Pluviseasonal lower mesotropical
Jujuy	2	San Salvador de Jujuy	urban	24°10′56″	065°16′25.56″	1289	Yungas	Pluviseasonal lower mesotropical
Jujuy	3	San Salvador de Jujuy	urban	24°10′35.81″	065°21′8.79″	1345	Yungas	Pluviseasonal lower mesotropical
Jujuy	4	San Salvador de Jujuy	urban	24°12′29.26″	065°7′55.89″	1298	Yungas	Pluviseasonal lower mesotropical
Jujuy	5	San Salvador de Jujuy	urban	24°13′54.11″	065°16′0.63″	1239	Yungas	Pluviseasonal lower mesotropical
Jujuy	6	San Salvador de Jujuy	urban	24°11′3.5″	065°18′51.66″	1300	Yungas	Pluviseasonal lower mesotropical
Jujuy	7	Chijra	suburban	24° 8′44.74″	065°17′42.61″	1374	Yungas	Pluviseasonal lower mesotropical
Jujuy	8	Chijra	suburban	24° 7′49.59″	065°17′54.67″	1413	Yungas	Pluviseasonal lower mesotropical
Jujuy	9	Reyes	periurban	24°10′14.65″	065°24′4.92″	1419	Yungas	Pluviseassonal upper mestotropical
Jujuy	10	Guerrero	periurban	24°10′44.05″	065°27′50.01″	1651	Yungas	Pluviseassonal upper mestotropical
Jujuy	11	Barro Blanco	suburban	24° 5′39.37″	065°17′13.62″	1490	Yungas	Pluviseassonal upper mestotropical
Jujuy	12	Ledesma	suburban	23°45′26.04″	064°51′0.66″	615	Yungas	Tropical pluviseassonal upper thermotropical
Jujuy	13	La Toma	suburban	24°19′11.17″	065°23′7.60″	1618	Chaco	Tropical pluviseassonal upper mesotropical
Jujuy	14	San Antonio	periurban	24°22′26.69″	065°20′0.83″	1325	Chaco	Tropical pluviseassonal upper mesotropical
Jujuy	15	Severino	suburban	24°21′4.21″	065°11′35.43″	1073	Chaco	Tropial xeric, lower mesotropical
Jujuy	16	Perico	periurban	24°22′50.55″	065°8′12.91″	972	Chaco	Temperate Subtropical
Jujuy	17	Tumbaya	suburban	23°52′44.60″	065°27′26.15″	2093	Perpuna	Tropical xeric lower supratropical
Jujuy	18	Maimara	urban	23°37′35.13″	065°24′24.56″	2396	Perpuna	Tropical xeric lower supratropical
Jujuy	19	Tilcara	periurban	23°34′3.21″	065°23′10.02″	2482	Perpuna	Tropical xeric lower supratropical
Jujuy	20	Huacalera	periurban	23°34′3.21″	065°21′4.73″	2651	Perpuna	Tropical xeric lower supratropical
Santiago del Estero	21	Santiago del Estero	periurban	27°46′34.5″	064°15′5.83″	185	Chaco	Tropical xeric, meso thermotropical
La Rioja	22	La Rioja	urban	29°26′9.8″	066°50′38.1″	496	Monte	Tropical xeric, meso thermotropical
La Rioja	23	La Rioja	periurban	29°26′22,55″	066°54′29,05″	593	Monte	Tropical xeric, meso thermotropical
La Rioja	24	Villa Sanagasta	urban	29°17′40.1″	067°1′12.5″	1005	Monte	Tropical xeric, supra thermotropical
La Rioja	25	Huaco	suburban	29°10′11.2″	067°3′10.3″	1217	Monte	Tropical xeric, supra thermotropical

entomological collection of the Centro de Investigaciones Entomológicas de Córdoba, Universidad Nacional de Córdoba, Argentina and Universidad Nacional de La Rioja, Argentina, whereas those from Jujuy and Santiago del Estero provinces are deposited in the entomological collection of the Instituto de Biología de la Altura, Universidad Nacional de Jujuy, Argentina.

Specimens were identified from larvae, males and females based on descriptions and redescriptions of the species and taxonomic keys by Consoli and de-Oliveira (1994), Darsie (1985), Forattini (2002), Lane (1953) and Schick (1970). The proposed taxonomic treatment of species in the tribe Aedini by Wilkerson et al. (2015) was followed.

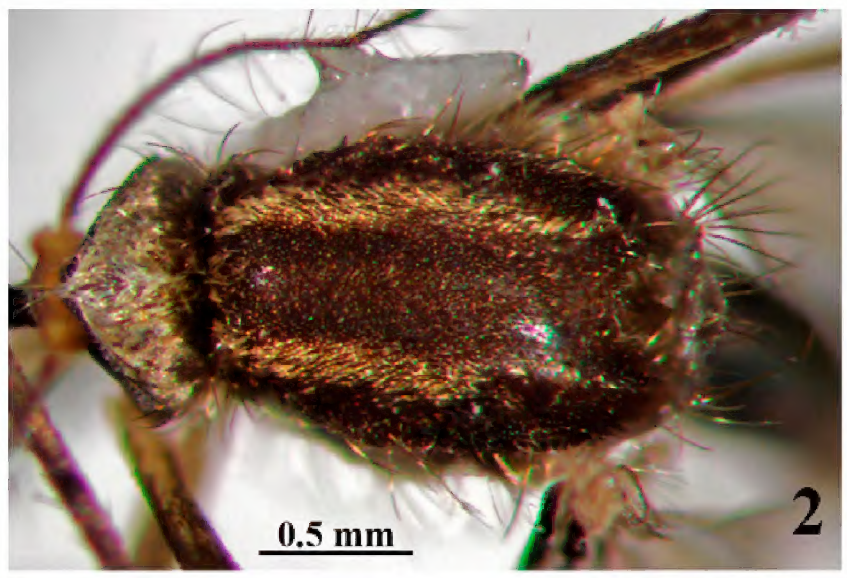
New records for Jujuy province (Figures 1A, 2–10)

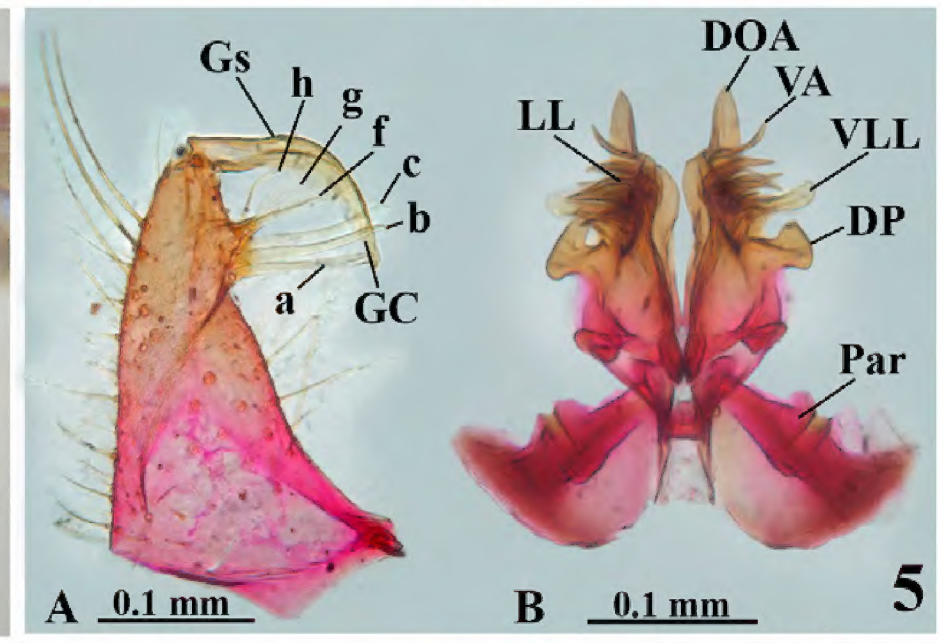
Aedes (Ochlerotatus) meprai Martínez & Prosen, 1953 (Figure 2)

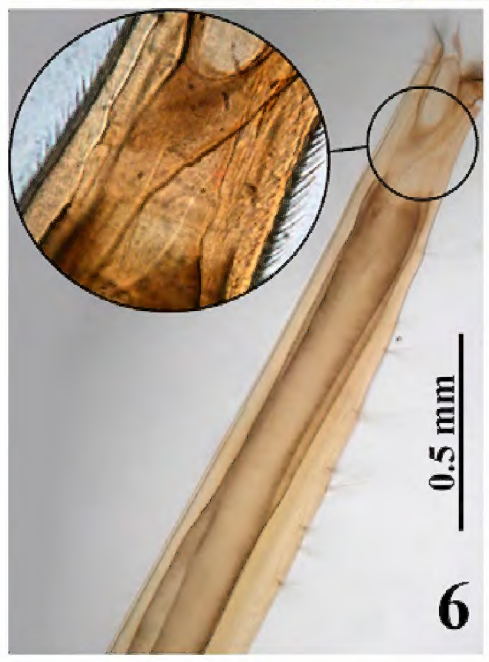
Aedes meprai is distinguishable from *Ae.* (*Oc.*) *crinifer* (Theobald, 1903) to present only two yellow-white flakes stripes on the scutum (Figure 2). Because we found only one larva of the species, we were unable to describe it. San Salvador de Jujuy: Site 1: Jan. 2011, 1F; Mar. 2011, 19F 3F; Apr. 2011, 9F; May. 2011, 1F; Nov. 2011, 1F; Dec. 2011, 1F, Feb. 2012, 1F; Mar 2012, 3F; Jun. 2012, 1F; Sep. 2012, 2F; Nov. 2012, 1F; Dec. 2012, 1F; Jan. 2013, 1F; Feb. 2013, 5F; Jan. 2014, 1F; Feb. 2014, 4F; Mar. 2014, 5F; Apr. 2014, 1F. Site 2: Mar. 2011, 2F; Dec. 2011, 1F; Feb. 2012, 1F; Mar. 2012, 2F; Jun. 2012, 2F; Nov. 2012, 1F; Dec. 2012, 2F; Jan. 2013, 3F; Feb. 2013, 3F; Mar. 2013, 1F; Feb. 2014, 3F; Mar. 2014, 6F; Apr. 2014, 1F; May. 2014, 1F. Site 3: Feb. 2011, 2F; Feb. 2012, 1F; Mar. 2012, 3F; Apr. 2012, 1F; Sep. 2012, 1F; Jan. 2013, 1F; Feb. 2013, 1F; Apr. 2013, 1F; Nov. 2013, 1F; Jan. 2014, 1F; Feb. 2014, 7F; Mar. 2014, 15F; Apr. 2014, 3F. Site 4: Mar. 2011, 1F; Apr. 2011, 4F; Feb. 2012, 1F; Mar. 2012, 2F; Apr. 2012, 1F; Nov. 2012, 1F, Feb. 2013, 2F. Site 5: Dec. 2010, 1F; Dec. 2013, 1F; Jan. 2014, 1F; Feb. 2014, 2F. Chijra (site 8): Feb. 2014, 1F. Linares coll.; Linares, Almirón and Stein det. Specimens Cul15-001 to 127. Current distribution in Argentina: Catamarca, Jujuy, Salta and Tucumán provinces.

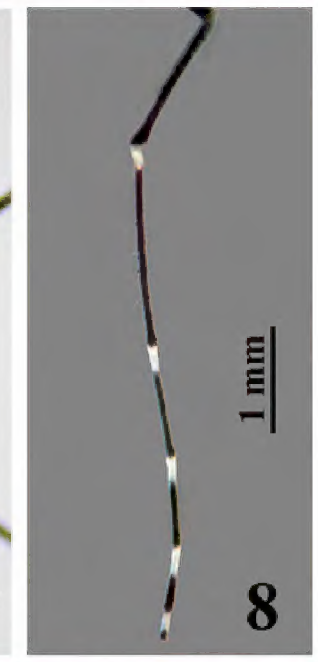
Aedes (Protomacleaya) casali Schick, 1970 (Figure 3)

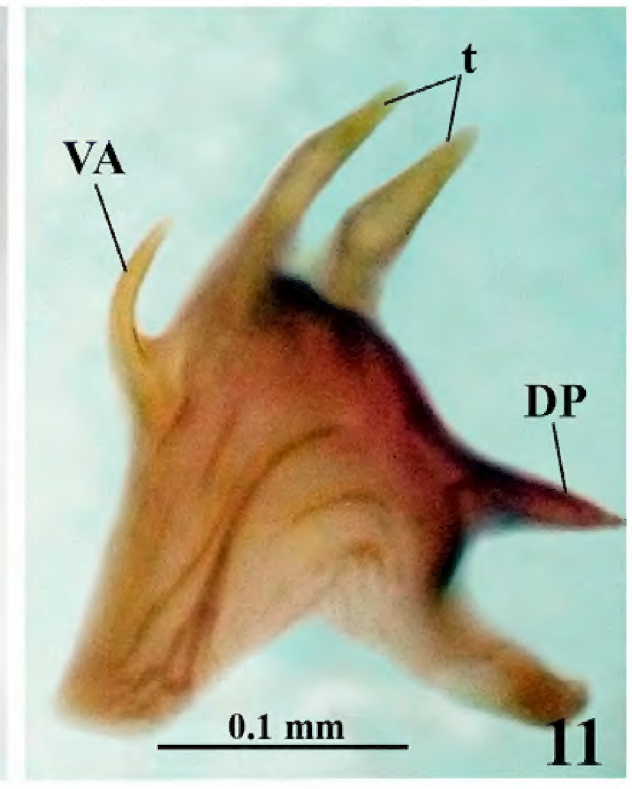
Our specimens have all characters presented by Schick (1970) (Figure 3) and were identified using the key by











Figures 2–11. New records of mosquitoes for Jujuy and Santiago del Estero provinces. **2:** *Aedes* (*Ochlerotatus*) *meprai* scutum. **3:** *Aedes* (*Protomacleaya*) *casali* lateral view. **4:** *Culex* (*Culex*) *dolosus* lateral view. **5:** *Cx. dolosus, male genitalia.* A: Gonocoxite (GC: gonostylar claw, Gs: gonostylus, a–c and f–h: setae). B: Phallosome (DOA: dorsal arm; DP: dorsal process; LL: lateral lobe; Par: paramere; VA: ventral arm; VLL: ventrolateral lobe). **6:** *Culex* (*Culex*) *saltanensis* siphon. **7:** *Culex* (*Microculex*) *imitator* lateral view. **8:** *Cx. imitator* III leg. **9:** *Cx. imitator* larva. **10:** *Psorophora* (*Janthinosoma*) *cyanescens* larva. **11:** *Culex* (*Culex*) *bidens* male genitalia (DP: Dorsal process; t: teeth; VA: Ventral arm).

that author. San Salvador de Jujuy: Site 1: Dec. 2011, 1F; May. 2012, 2F; Oct. 2012, 1F; Nov. 2012, 1F; Feb. 2013, 1F; Feb. 2014, 3F; Mar. 2014, 16F; Apr. 2014, 1F. Site 2: Feb. 2012, 4F; Mar. 2012, 4F; Jun. 2012, 1F; Feb. 2013, 1F; Jun. 2013, 1F; Mar. 2014, 1F; Apr. 2014, 1F. Linares coll. and det. Cul21-001 to 039. Current distribution in Argentina: Jujuy, Salta and Tucumán provinces.

Culex* (*Culex*) *dolosus (Lynch Arribálzaga, 1891) (Figures 4, 5)

Males of *Cx. dolosus* are identified by the lateral lobe of the phallosome (Figure 5) with a projection and the ventral arm longer than teeth of the lateral arm. Females are identified by the presence of yellowish antealar scales and postespiracular white scales.

San Salvador de Jujuy: Site 1: Oct. 2011, 2F, Jun. 2012, 1F. Site 2: Mar. 2011, 1F, Dec. 2011, 1F, Sep. 2012, 2F; Nov. 2012 1F, Jun. 2013, 3F, Oct. 2013, 1F. Site 3: Sep. 2012, 3M, 3MG, Oct. 2012, 1M, 1MG, Jan. 2013, 1F, May. 2013, 1M, 1MG; Dec. 2013, 3F. Site 4: Nov. 2012, 2F, May. 2014 1M, 1MG. Site 5: Sep. 2012, 1M, 1MG. Chijra (site 7): Jul. 2013, 1M, 1MG. Reyes (site 9): Sep. 2011, 1F, 2M, 2MG; Nov. 2011, 1M, 1MG, 1 Pe, 1Le; Oct. 2012, 1M, 1MG. Guerrero (site 10): Mar. 2015, 1M, 1MG. Barro Blanco (site 11): Aug. 2013, 1M. Sep. 2013, 1F. La Toma (site 13): Jun. 2014, 1M. San Antonio (site 14): Sep. 2011, 2M, 2MG, 1Le. Severino (site 15): Aug. 2012; 1M, 1MG. Maimara (site 18): Feb. 2014, 1F. Tilcara (site 19): Jun. 2014, 2M, 2MG; Dec. 2015, 8L. Huacalera (site 20): Jan. 2015, 1M, 1MG. Linares coll., Laurito det. Larvae were collected in shady habitas, including two pools with dense masses of semi-submerged vegetation and in artificial ponds, lagoons and animal tracks. Specimens Cul39-001 to 048. Current distribution in Argentina: Buenos Aires, Chubut, Córdoba, Corrientes, Entre Ríos, Jujuy, La Pampa, La Rioja, Mendoza, Misiones, Neuquén, Río Negro, Salta, Santa Fe and Tucumán provinces.

Culex* (*Culex*) *saltanensis Dyar, 1928 (Figure 6)

Larvae are easily recognizable by the presence of spicules in the apical third of the siphon (Figure 6) in addition to the characteristic of the male genitalia (Laurito et al. 2008).

Perico (site 16): May. 2015; 5M, 2F, 2Pe, 3L, 2Le. Linares coll., Laurito and Linares det. Larvae were collected from an artificial concrete pond with high sun exposure. The water in the pond was green due to a large amount of algae and organic matter in suspension. Tumbaya (site 17): Mar. 2015, 1F, 1LE, 1PE. Linares coll. Rossi det. Specimens Cul46-001 to 010. Current distribution in Argentina: Catamarca, Chaco, Córdoba, Corrientes, Formosa, Jujuy, La Pampa, La Rioja, Misiones, Salta, San Juan, Santa Fe, Santiago del Estero and Tucumán provinces.

Culex* (*Microculex*) *imitator Theobald, 1903 (Figures 7–9)

This is the only representative of its subgenus in northwestern Argentina. Silver markings lyre shaped, leaving relatively obvious areas of brown scales on mesonotum, and the bands of clear scales on tarsus allow for the identification of adults (Figures 7, 8) (Lane and Whitman 1951). Larvae (Figure 9) may be distinguished by the following characteristics: prothoracic formula 1-(1-2) - (4-6) - (1-2) -1-1-1; combs in VIII segment with 60 spines; siphonal index close to 12 and the anal papilla three times longer than segment X.

San Salvador de Jujuy: Site 1: Mar. 2011, 1L, 1F, 1M; Jul. 2012, 2L; Aug. 2012, 2L; Mar. 2014 1F; May. 2014, 3F. Site 2: Mar. 2011, 1L, 3F, 3M; Feb. 2012, 1F, 2M; May. 2012, 2L; Jul. 2012, 3L, 7LE, 6PE, 6M, 2F; Sep. 2012, 1F, 1M; Dec. 2012, 2L; Feb. 2014, 4L. Linares coll., Linares and Stein det. Site 6: Mar. 2015, 2M, 2Le. Corregidor coll. Linares det. Ledesma (site 12): May 2012, 2F. San Antonio (site 14): Mar. 2014, 1F, 2M. Linares coll. Linares and Stein det. Larvae were collected from *Tillandsia australis* Mez, and *Aechmea distichantha* Lemaire (Bromeliaceae), both at ground level and at three meters high on trees in shaded environments. Specimens Cul54-001 to 051. Current distribution in Argentina: Chaco, Corrientes, Formosa, Jujuy, Misiones, Salta, Santa Fe and Tucumán provinces.

Psorophora* (*Janthinosoma*) *cyanescens (Coquillett, 1902) (Figure 10)

This species is easily recognizable in the larval stage by the antennae shorter than head, a single seta 6-C and the presence of comb scales that arise from a chitinous plate on VIII segment.

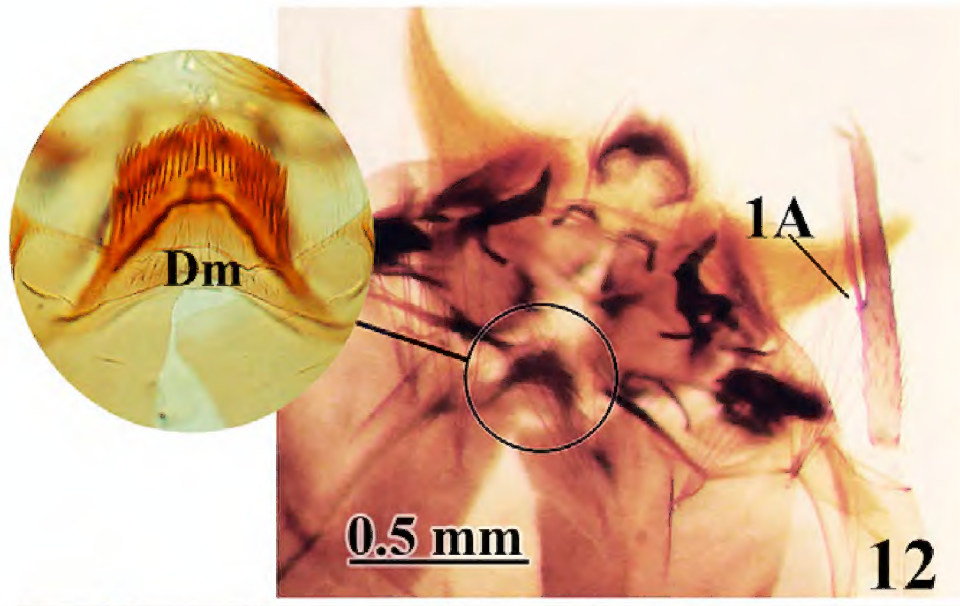
Perico (site 16): May 2014, 1L. Linares coll.; Linares, Rossi and Stein det. Larva was collected in a clear pool of rainwater and flooded grass in the shadows of trees. Specimen Cul72-001. Current distribution in Argentina: Buenos Aires, Catamarca, Chaco, Córdoba, Corrientes, Entre Ríos, Formosa, Jujuy, La Rioja, Mendoza, Misiones, Salta, Santa Fe, Santiago del Estero and Tucumán provinces.

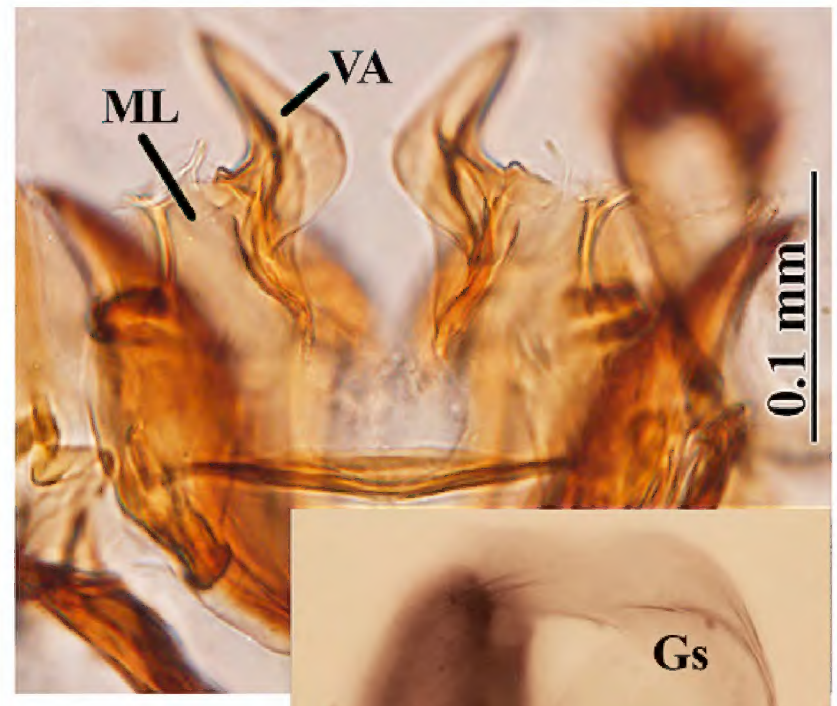
New record for Santiago del Estero province (Figures 1, 11)

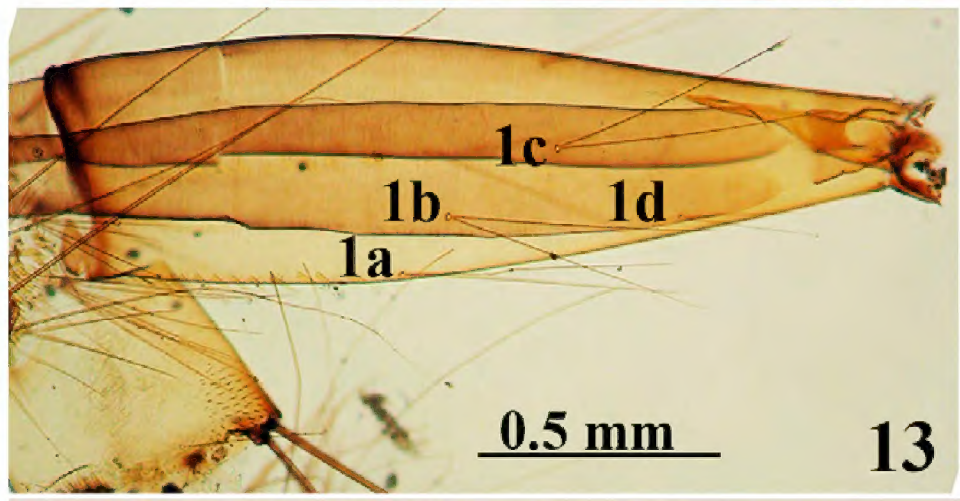
Culex* (*Culex*) *bidens Dyar, 1922

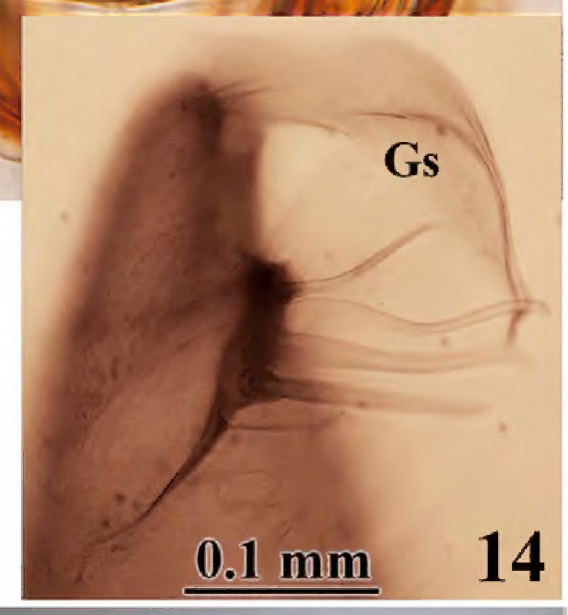
The male of *Cx. bidens* is identified by the lateral plate of the phallosome with 1–3 (usually 2) large dorsolaterally directed teeth (Figure 11), 0–3 minute conical denticles and ventral arm as a spine bent dorsolaterally (Figure 11) (Laurito and Almirón 2015).

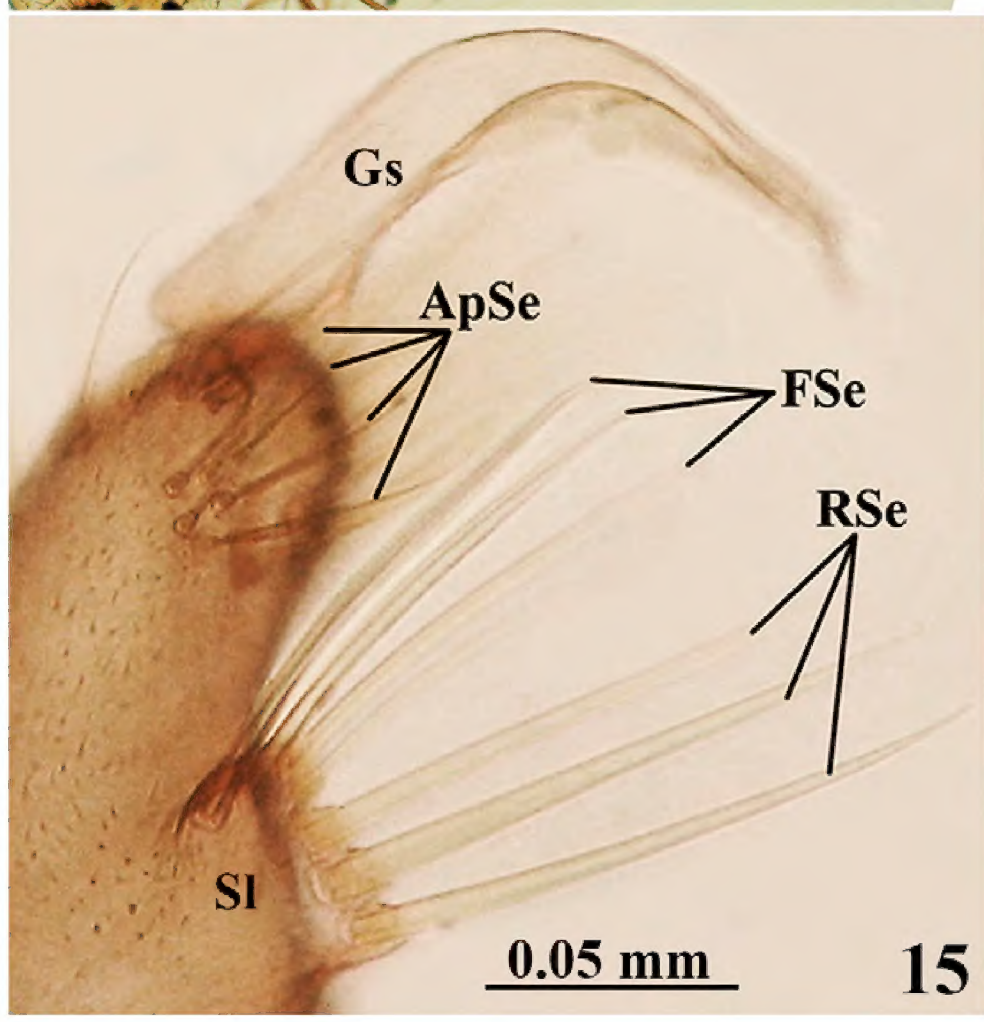
Santiago del Estero (site 21): Oct. 2014, 1M, 1MG, 1L. Linares coll., Laurito det. Larva was collected in a backwater of the Misky-Mayu River. The site presented great sun exposure and abundant semi-submerged vegetation. Specimen Cul35-015. Current distribution











Figures 12–16. New records of mosquitoes for La Rioja province. **12:** *Culex* (*Culex*) *acharistus* head (Dm: dorsomentum; 1A: seta 1 of antenna). **13:** *Cx. acharistus* siphon (1a-d: siphonal setae). **14:** *Cx. acharistus* male genitalia (Gs: Gonostylus; ML: Mesal lobe; VA: Ventral arm). **15:** *Culex* (*Culex*) *coronator* male genitalia. (ApSe: apical setae; FSe: filiform setae; Gs: Gonostylus; RSe: rod-like setae; SL: Subapical lobe. **16:** *Haemagogus* (*Haemagogus*) *janthinomys* lateral view.

in Argentina: Buenos Aires, Catamarca, Chaco, Córdoba, Corrientes, Entre Ríos, Formosa, Jujuy, La Pampa, La Rioja, Misiones, Salta, Santa Fe, Santiago del Estero and Tucumán provinces.

New records for La Rioja province (Figures 1B, 12–16)

Culex* (*Culex*) *acharistus Root, 1927

This species can be distinguished in its larval stage by the shape of the dorsomentum (Figure 12), the insertion of seta 1-A near the middle of the antenna (Figure 12), the sclerotized and minutely denticulate plate of the abdominal segments and the shape of siphon (Figure 13). The diagnostic male genitalia features are: gonostylus with normal appearance in lateral view, distal 0.75 slightly broader, apical third with minute annulations, and dorsal and lateral arm of the phallosome absent (Figure 14) (Harbach and Knight 1980, 1982).

Huaco (site 25): Apr. 2015; 1M, 1MG, 1Le, 1Pe. Laurito and Visintin coll., Laurito det. Immature stages were collected from shaded, vegetation-free, rocky temporary pools. Specimen LR1556. Current distribution in Argentina: Buenos Aires, Catamarca, Chubut, Córdoba, Corrientes, Jujuy, La Rioja, Misiones, Neuquén, Río Negro and Tucumán provinces.

Culex* (*Culex*) *coronator Dyar & Knab, 1906

The identification was based on male genitalia. The subapical lobe of the gonocoxite is more-or-less divided with two or three subequal strong rod-like setae on the proximal part of the lobe and several subequal filiform setae on the distal part of the lobe (Figure 15); the gonocoxite has an apical cluster of fine and short setae (Figure 15) (Bram 1967).

La Rioja (sites 22 and 23): Apr. 2015. 8M, 8MG, 4Pe, 4Le. Specimens LR1515, LR1550, LR1552 to 1555, LR1558, LR1574. Villa de Sanagasta (site 24): Apr. 2015, 7M, 7MG, 4Pe, 4Le. Specimens LR1511, LR1513, LR1532, LR1567, LR1569, LR1570, LR1573. Laurito and Visintin coll., Laurito det. Immature stages were collected from a shaded, grass-covered puddle. Current distribution in Argentina: Buenos Aires, Catamarca, Chaco, Córdoba, Corrientes, Entre Ríos, Formosa, Jujuy, La Rioja, Misiones, Río Negro, Salta and Tucumán provinces.

Haemagogus* (*Haemagogus*) *janthinomys Dyar, 1921 (Figure 16)

Although similar to *Hg. capricornii* Lutz, 1904, Martínez et al. (1965) and Arnell (1973) indicated *Hg. janthinomys* is present in Argentina.

La Rioja city (site 23), Periurban: Jan. 2014, F, Feb2014, F, May. 2014, 2F. Visintin coll. and det. Specimens LRc0101 to 0107. Current distribution in Argentina: Catamarca, Jujuy, La Rioja, Salta and Tucumán provinces.

Culex acharistus and *Cx. coronator* are widely distributed species in Argentina. Our finds of these two species in La Rioja province fill gaps to show that their distributions are continuous along the western mountainous area of Argentina (Laurito et al. 2009; Rossi and Vezzani 2011). *Haemagogus janthinomys* has been recorded from the mountainous area of the country (Rossi 2015), and we extend here its southernmost limit.

Most species reported here are associated with the transmission of arboviruses and other pathogens. In 2005, pools of *Cx. coronator* were positive for West Nile Virus (Flaviviridae: *Flavivirus*) in the United States (CDC 2015). In the same year, pools of *Cx. coronator* tested positive for Venezuelan Equine Encephalitis Virus (Togaviridae: *Alphavirus*) in Chaco province, Argentina (Pisano et al. 2010). *Culex acharistus* and *Cx. bidens* were suspected to be the vector of Eastern Equine Encephalitis Virus (Togaviridae: *Alphavirus*) during the 1988 epizootic in Chaco province (Sabattini et al. 1998). *Culex saltanensis* females are considered the primary vector of *Plasmodium juxtanucleare*, which affects chickens (Consoli and de Oliveira 1994) and are also efficient experimental vectors of *P. cathemerium*, another avian parasite (de Oliveira and Castro 1991). Furthermore, *Hg. janthinomys* is considered the main selvatic yellow fever vector species (Consoli and de Oliveira 1994), and was involved in several outbreaks of Yellow Fever Virus (Flaviviridae: *Flavivirus*-YFV) in Central and South America (Chadee et al. 1992; Degallier et al. 1992; Muñoz-Rodriguez et al. 2010; Vasconcelos et al. 1997), by Mayaro Virus (Togaviridae: *Alphavirus*) in Brazil (Holch et al. 1981) and Venezuela (Muñoz and Navarro 2012). *Psorophora cyanescens,* among other species of the same genus, has been indicated as a potential vector of Venezuelan Encephalitis Virus (Mesa et al. 2005). Muñoz-Rodriguez et al. (2010) found that this species has high anthropophily and is therefore of high health interest.

Knowledge of the distributions of mosquito species is of great sanitary interest. This contribution updates the mosquito fauna of Argentina, and increases the number of species for the provinces of Jujuy, La Rioja and Santiago del Estero from 55 to 62, 22 to 25 and 25 to 26, respectively.

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